WHAT IS CLAIMED IS:

1. A method of controlling a catalytic combustion system comprising a flame burner, a fuel injector positioned downstream of the flame burner and a catalyst positioned downstream of the fuel injector, wherein a portion of the fuel combusts within the catalyst and a remainder of the fuel combusts in the region downstream of the catalyst, comprising:

determining the fuel air ratio at the catalyst inlet; and

adjusting the gas temperature at the catalyst inlet to a preferred value based upon a predetermined schedule between the fuel air ratio and the gas temperature at the catalyst inlet.

2. The method of claim 1, wherein the fuel air ratio is determined by monitoring the fuel flow to said fuel injector and monitoring the air flow to the combustor.

3 The method of claim 2, wherein the air flow to the combustor is determined by measuring pressure drop at the inlet bell mouth of a compressor supplying air to the combustor.

4. The method of claim 1, wherein the gas temperature at the catalyst inlet is adjusted by changing the fuel flow to the flame burner.

5. The method of claim 1, wherein the gas temperature at the catalyst inlet is adjusted by changing the percentages of fuel split between the flame burner and the injector.

6. A method of controlling a catalytic combustion system comprising a flame burner, a fuel injector positioned downstream of the flame burner and a catalyst positioned downstream of the fuel injector, wherein a portion of the fuel combusts within the catalyst and a remainder of the fuel combusts in the region downstream of the catalyst, comprising:

determining the adiabatic combustion temperature at the catalyst inlet; and

adjusting the gas temperature at the catalyst inlet to a preferred value based upon a predetermined schedule between the adiabatic combustion temperature and the gas temperature at the catalyst inlet.

7. The method of claim 6, wherein the adiabatic combustion temperature is determined by monitoring the total fuel flow to the combustor, the total air flow to the combustor and the temperature of the gas entering the combustor.

8. The method of claim 6, wherein the adiabatic combustion temperature is determined by monitoring the fuel flow to the injector upstream of the catalyst, the total air flow to the combustor and the temperature of the gas entering the injector.

9. The method of claim 8, wherein the air flow to the combustor is determined by measuring pressure drop at the inlet bell mouth of a compressor supplying air to the combustor.

10. The method of claim 6, wherein the gas temperature at the catalyst inlet is adjusted by changing the fuel flow to the flame burner.

11. The method of claim 1, wherein the gas temperature at the catalyst inlet is adjusted by changing the percentages of fuel split between the flame burner and the injector.

12. A method of controlling a catalytic combustion system comprising a heat exchanger that uses the exhaust gas to provide heat to the air entering a combustor, a fuel injector positioned downstream of the heat exchanger and a catalyst positioned downstream of the fuel injector, wherein a portion of the fuel combusts within the catalyst and a remainder of the fuel combusts in the region downstream of the catalyst, comprising:

determining the fuel air ratio at the catalyst inlet; and

adjusting the catalyst inlet gas temperature to a preferred value based upon a predetermined schedule between the fuel air ratio at the catalyst inlet and the temperature at the catalyst inlet by adjusting the fraction of combustion air flowing through the heat exchanger.

13. A method of controlling a catalytic combustion system comprising a heat exchanger that uses the process exhaust heat to provide heat to the air entering a combustor, a fuel injector positioned downstream of the heat exchanger and a catalyst positioned downstream of the fuel injector, wherein a portion of the fuel combusts within the catalyst and a remainder of the fuel combusts in the region downstream of the catalyst, comprising:

determining the fuel air ratio at the catalyst inlet; and

adjusting the catalyst inlet gas temperature to a preferred value based upon a predetermined schedule between the fuel air ratio at the catalyst inlet and the temperature at the catalyst inlet by adjusting the fraction of exhaust flowing through the heat exchanger.

14. A method of controlling a catalytic combustion system comprising a heat exchanger that uses the exhaust gas to provide heat to the air entering a combustor, a fuel injector positioned downstream of the heat exchanger and a catalyst positioned downstream of the fuel injector, wherein a portion of the fuel combusts within the catalyst and a remainder of the fuel combusts in the region downstream of the catalyst, comprising:

determining the adiabatic combustion temperature at the catalyst inlet; and

adjusting the catalyst inlet gas temperature to a preferred value based upon a predetermined schedule between the adiabatic combustion temperature at the catalyst inlet and the temperature at the catalyst inlet by adjusting the fraction of exhaust flowing through the heat exchanger.

15. The method of claim 14, wherein the adiabatic combustion temperature is determined by monitoring the total fuel flow to the combustor, the total air flow to the combustor and the temperature of the gas entering the combustor.

16. The method of claim 14, wherein the adiabatic combustion temperature is determined by monitoring the fuel flow to the injector upstream of the catalyst, the total air flow to the combustor and the temperature of the gas entering the injector.

17. The method of claim 15, wherein the air flow to the combustor is determined by measuring pressure drop at the inlet bell mouth of a compressor supplying air to the combustor.

18. The method of claim 16, wherein the air flow to the combustor is determined by measuring pressure drop at the inlet bell mouth of a compressor supplying air to the combustor.

19. A method of controlling a catalytic combustion system comprising a heat exchanger that uses the exhaust gas to provide heat to the air entering a combustor, a fuel

injector positioned downstream of the heat exchanger and a catalyst positioned downstream of the fuel injector, wherein a portion of the fuel combusts within the catalyst and a remainder of the fuel combusts in the region downstream of the catalyst, comprising:

determining the adiabatic combustion temperature at the catalyst inlet; and

adjusting the catalyst inlet gas temperature to a preferred value based upon a predetermined schedule between the adiabatic combustion temperature at the catalyst inlet and the temperature at the catalyst inlet by adjusting the fraction of combustion air flowing through the heat exchanger.

20. The method of claim 19, wherein the adiabatic combustion temperature is determined by monitoring the total fuel flow to the combustor, the total air flow to the combustor and the temperature of the gas entering the combustor.

21. The method of claim 19, wherein the adiabatic combustion temperature is determined by monitoring the fuel flow to the injector upstream of the catalyst, the total air flow to the combustor and the temperature of the gas entering the injector.

22. The method of claim 20, wherein the air flow to the combustor is determined by measuring pressure drop at the inlet bell mouth of a compressor supplying air to the combustor.

23. The method of claim 21, wherein the air flow to the combustor is determined by measuring pressure drop at the inlet bell mouth of a compressor supplying air to the combustor.

24. A method of controlling a catalytic combustion system comprising a flame burner, a fuel injector positioned downstream of the flame burner and a catalyst positioned downstream of the fuel injector, wherein a portion of the fuel combusts within the catalyst and the remainder of the fuel combusts in the region downstream of the catalyst comprising:

measuring the exhaust gas temperature; and

adjusting the catalyst inlet gas temperature to a preferred value based upon a predetermined schedule that relates the catalyst inlet gas temperature to the difference between the measured exhaust gas temperature and the calculated exhaust gas temperature at full load.

25. The method of claim 24, wherein the gas temperature at the catalyst inlet is adjusted by changing the fuel flow to the flame burner.

26. The method of claim 24, wherein the gas temperature at the catalyst inlet is adjusted by changing the percentages of fuel split between the flame burner and the injector.

27. The method of claim 24, wherein the exhaust gas temperature is measured with a thermocouple measuring the gas temperature downstream of the process.

28. The method of claim 24, wherein the temperature at the inlet of the catalyst is measured with a thermocouple monitoring the temperature of the gas at the catalyst inlet.

29. A method of controlling a catalytic combustion system comprising a flame burner, a fuel injector positioned downstream of the flame burner and a catalyst positioned downstream of the fuel injector, wherein a portion of the fuel combusts within the catalyst and the remainder of the fuel combusts in the region downstream of the catalyst in a homogeneous combustion process wave comprising:

positioning a sensor to monitor the region downstream of the catalyst, the sensor having an output signal responsive to the location of the homogeneous combustion process wave; and

using the sensor signal to adjust the catalyst inlet gas temperature to control the position of the homogeneous combustion process wave.

30. The method of claim 29, wherein using the sensor signal to adjust catalyst inlet gas temperature comprises:

adjusting the catalyst inlet gas temperature based upon a predetermined schedule between the measured exhaust gas temperature and the calculated exhaust gas temperature at full load; and

modifying the predetermined schedule based upon the sensor signal.

31. The method of claim 29, wherein using the sensor signal to adjust catalyst inlet gas temperature comprises:

adjusting the catalyst inlet gas temperature based upon a predetermined schedule between the fuel air ratio and the catalyst inlet gas temperature; and

modifying the predetermined schedule based upon the sensor signal.

32. The method of claim 29, wherein using the sensor signal to adjust catalyst inlet gas temperature comprises:

adjusting the catalyst inlet gas temperature based upon a predetermined schedule between the adiabatic combustion temperature and the catalyst inlet gas temperature; and

modifying the predetermined schedule based upon the sensor signal.

33. The method of claim 29, wherein using the sensor signal to adjust catalyst inlet gas temperature comprises:

adjusting the catalyst inlet gas temperature based upon a predetermined series of schedules between the adiabatic combustion temperature and the catalyst inlet gas temperature; and

selecting the predetermined schedule from among the series of schedules based upon the sensor signal.

34. The method of claim 29, wherein using the sensor signal to adjust catalyst inlet gas temperature comprises:

adjusting the catalyst inlet gas temperature based upon a predetermined schedule between the fuel air ratio and the catalyst inlet gas temperature; and

modifying the predetermined schedule based upon the sensor signal.

35. The method of claim 29, wherein using the sensor signal to adjust catalyst inlet gas temperature comprises:

adjusting the catalyst inlet gas temperature based upon a predetermined series of schedules between the fuel air ratio and the catalyst inlet gas temperature; and

selecting the predetermined schedule from among the series of schedules based upon the sensor signal.

36. The method of claim 29, wherein using the sensor signal to adjust catalyst inlet gas temperature comprises:

adjusting the catalyst inlet gas temperature based upon a predetermined schedule that relates the difference between: (i)the measured exhaust gas temperature and the calculated exhaust gas temperature at full load, and (ii)the catalyst inlet gas temperature; and

modifying the predetermined schedule based upon the sensor signal.

37. The method of claim 29, wherein using the sensor signal to adjust catalyst inlet gas temperature comprises:

adjusting the catalyst inlet gas temperature based upon a predetermined series of schedules that relates: (i) the difference between the measured exhaust gas temperature and the calculated exhaust gas temperature at full load, and (ii)the catalyst inlet gas temperature; and

selecting the predetermined schedule from among the series of schedules based upon the sensor signal.

38. The method of Claim 29, in which the sensor is an optical sensor that is sensitive in the radiation spectral region of 100 to 1000 nanometers wavelength.

39. The method of Claim 29, in which the sensor is an optical sensor that is sensitive in the radiation spectral region of 200 to 400 nanometers wavelength.

40. The method of Claim 29, in which the sensor is a charged ion sensor.

41. The method of Claim 29, in which the sensor is a temperature sensor in the gas downstream of the catalyst.

42. The method of claim 29, in which the sensor is located on the wall of the post catalyst reaction zone chamber.

43. The method of claim 29, wherein gas is extracted from the region downstream of the catalyst and the sensor measures the temperature of the extracted gas.

44. The method of claim 29, wherein gas is extracted from the region downstream of the catalyst and the sensor measures the concentration of carbon monoxide or uncombusted fuel in the extracted gas.

45. The method of claim 29, in which the sensor comprises a carbon monoxide or hydrocarbon sensor at the exhaust of the combustion process and position of the homogeneous combustion process wave is determined from the measured concentration of carbon monoxide or hydrocarbons.

46. The method of claim 29, wherein the gas temperature at the catalyst inlet is adjusted by changing the fuel flow to the flame burner.

47. The method of claim 29, wherein the gas temperature at the catalyst inlet is adjusted by changing the percentages of fuel split between the flame burner and the injector.

48. A system for controlling a catalytic combustion system, comprising:

a flame burner;

a fuel injector positioned downstream of the flame burner;

a catalyst positioned downstream of the fuel injector, wherein a portion of the fuel combusts within the catalyst and a remainder of the fuel combusts in the region downstream of the catalyst;

a system for determining the fuel air ratio at the catalyst inlet; and

a system for adjusting the gas temperature at the catalyst inlet to a preferred value based upon a predetermined schedule between the fuel air ratio and the gas temperature at the catalyst inlet.

49. A system for controlling a catalytic combustion system, comprising:

a flame burner;

a fuel injector positioned downstream of the flame burner;

a catalyst positioned downstream of the fuel injector, wherein a portion of the fuel combusts within the catalyst and a remainder of the fuel combusts in the region downstream of the catalyst;

a system for determining the adiabatic combustion temperature at the catalyst inlet; and

a system for adjusting the gas temperature at the catalyst inlet to a preferred value based upon a predetermined schedule between the adiabatic combustion temperature and the gas temperature at the catalyst inlet.

50. A system for of controlling a catalytic combustion system, comprising:

a flame burner;

a fuel injector positioned downstream of the flame burner;

catalyst positioned downstream of the fuel injector, wherein a portion of the fuel combusts within the catalyst and the remainder of the fuel combusts in the region downstream of the catalyst;

a system for measuring the exhaust gas temperature; and

a system for adjusting the catalyst inlet gas temperature to a preferred value based upon a predetermined schedule that relates the catalyst inlet gas temperature to the difference between the measured exhaust gas temperature and the calculated exhaust gas temperature at full load.

51. A system for controlling a catalytic combustion system, comprising:

a flame burner;

a fuel injector positioned downstream of the flame burner;

a catalyst positioned downstream of the fuel injector, wherein a portion of the fuel combusts within the catalyst and the remainder of the fuel combusts in the region downstream of the catalyst in a homogeneous combustion process wave;

a sensor positioned to monitor the region downstream of the catalyst, the sensor having an output signal responsive to the location of the homogeneous combustion process wave; and

a system for using the sensor signal to adjust the catalyst inlet gas temperature to control the position of the homogeneous combustion process wave.

52. The system of claim 51, wherein the system for using the sensor signal to adjust the catalyst inlet gas temperature comprises:

a system for adjusting the catalyst inlet gas temperature based upon a predetermined schedule between the measured exhaust gas temperature and the calculated exhaust gas temperature at full load; and

a system for modifying the predetermined schedule based upon the sensor signal.

53. The system of claim 52, wherein the system for using the sensor signal to adjust the catalyst inlet gas temperature comprises:

a system for adjusting the catalyst inlet gas temperature based upon a predetermined schedule between the fuel air ratio and the catalyst inlet gas temperature; and

a system for modifying the predetermined schedule based upon the sensor signal.

54. The system of claim 52, wherein the system for using the sensor signal to adjust the catalyst inlet gas temperature comprises:

a system for adjusting the catalyst inlet gas temperature based upon a predetermined schedule between the adiabatic combustion temperature and the catalyst inlet gas temperature; and

a system for modifying the predetermined schedule based upon the sensor signal.

55. The system of claim 52, wherein the system for using the sensor signal to adjust the catalyst inlet gas temperature comprises:

a system for adjusting the catalyst inlet gas temperature based upon a predetermined schedule between the fuel air ratio and the catalyst inlet gas temperature; and

a system for modifying the predetermined schedule based upon the sensor signal.

56. The system of claim 52, wherein the system for using the sensor signal to adjust the catalyst inlet gas temperature comprises:

a system for adjusting the catalyst inlet gas temperature based upon a predetermined schedule that relates the difference between: (i)the measured exhaust gas temperature and the calculated exhaust gas temperature at full load, and (ii)the catalyst inlet gas temperature; and

a system for modifying the predetermined schedule based upon the sensor signal.

57. The system of claim 52, wherein the sensor is an optical sensor that is sensitive in the radiation spectral region of 100 to 1000 nanometers wavelength.

58. The system of claim 52, wherein the sensor is an optical sensor that is sensitive in the radiation spectral region of 200 to 400 nanometers wavelength.

59. The system of claim 52, wherein the sensor is a charged ion sensor.

60. The system of claim 52, wherein the sensor is a temperature sensor in the gas downstream of the catalyst.

61. The system of claim 52, wherein the sensor is located on the wall of the post catalyst reaction zone chamber.

62. The system of claim 52, further comprising:

a system for extracting gas from a region downstream of the catalyst, wherein the sensor measures the temperature of the extracted gas.

63. The system of claim 52, further comprising:

a system for extracting gas from a region downstream of the catalyst, wherein the sensor measures the concentration of carbon monoxide or uncombusted fuel in the extracted gas.

64. The system of claim 52, wherein the sensor comprises a carbon monoxide or hydrocarbon sensor at the exhaust of the combustion process and position of the homogeneous combustion process wave is determined from the measured concentration of carbon monoxide or hydrocarbons.

65. A catalytic combustion system, comprising:

a catalyst, wherein fuel partially combusts within the catalyst a remainder of the fuel combusts in the region downstream of the catalyst in a homogeneous combustion wave; and

a sensor located downstream of the catalyst to monitor the homogeneous combustion wave.

66. The system of claim 65, wherein the sensor is an optical sensor that is sensitive in the radiation spectral region of 100 to 1000 nanometers wavelength.

67. The system of claim 65, wherein the sensor is an optical sensor that is sensitive in the radiation spectral region of 200 to 400 nanometers wavelength.

68. The system of claim 65, wherein the sensor is a charged ion sensor.

69. The system of claim 65, wherein the sensor is positioned to monitor the region immediately downstream of the exit face of the catalyst.

70. A method of modifying an operating line used to control a catalytic combustion system comprising a flame burner, a fuel injector positioned downstream of the flame burner and a catalyst positioned downstream of the fuel injector, wherein a portion of the fuel combusts within the catalyst and the remainder of the fuel combusts in the region downstream of the catalyst in a homogeneous combustion process wave, and a sensor located

downstream of the catalyst, wherein the operating line has an expected sensor signal, comprising:

stepwise changing the catalyst inlet gas temperature;

monitoring the sensor signal;

calculating a difference between the measured sensor signal and the expected sensor signal; and

modifying the operating line based on the calculated difference between the measured sensor signal and the expected sensor signal.

71. The method of claim 70, further comprising informing an operator that the rate of change in movement of the operating line over time is above a predetermined limit by:

pre-determining an expected rate of change of the operating line over time,

measuring the rate of change of the operating line over time; and

informing an operator that the rate of change in movement of the operating line over time is above a predetermined limit when the measured rate of change of the operating line exceeds the expected rate of change of the operating line.

72. The method of claim 71, wherein pre-determining an expected rate of change of the operating line over time comprises determining an expected rate of change of the operating line from a model of the catalyst or combustor system.

73. The method of claim 72, wherein the model uses operating conditions of the gas turbine and combustor system to determine catalyst operating conditions to thereby determine an expected rate of change of the operating line.

74. The method of claim 71, further comprising estimating the remaining time in which the combustion system will meet preferred emissions performance by:

comparing the measured rate of change of the operating line over time with the expected rate of change of the operating line over time.